WHAT IS CLAIMED IS:

1. An alloy carbon steel comprising iron and a maximum of 0.35% by weight of carbon, said alloy carbon steel having a triple-phase microstructure comprising ferrite crystals fused with martensite-austenite crystals, said martensite-austenite crystals comprising laths of martensite alternating with thin films of austenite.

2. An alloy carbon steel in accordance with claim **1** in which said martensite-austenite crystals are devoid of carbide precipitates at interfaces between phases.

3. An alloy carbon steel in accordance with claim **1** in which martensite-austenite crystals constitute from about 5% to about 95% by weight of said triple-phase microstructure.

4. An alloy carbon steel in accordance with claim **1** in which said martensite-austenite crystals constitute from about 15% to about 60% by weight of said triple-phase microstructure.

5. An alloy carbon steel in accordance with claim **1** in which said martensite-austenite crystals constitute from about 20% to about 40% by weight of said triple-phase microstructure.

6. An alloy carbon steel in accordance with claim **1** in which said carbon constitutes from about 0.01% to about 0.35% by weight of said triple-phase microstructure.

7. An alloy carbon steel in accordance with claim **1** in which said carbon constitutes from about 0.03% to about 0.3% by weight of said triple-phase microstructure.

8. An alloy carbon steel in accordance with claim **1** in which said carbon constitutes from about 0.05% to about 0.2% by weight of said triple-phase microstructure.

9. An alloy carbon steel in accordance with claim **1** further comprising silicon at a concentration of from about 0.1% to about 3% by weight of said alloy composition.

10. An alloy carbon steel in accordance with claim **1** further comprising silicon at a concentration of from about 1% to about 2.5% by weight of said alloy composition.

11. An alloy carbon steel in accordance with claim **1** in which said carbon constitutes from about 0.03% to about 0.3% by weight of said triple-phase microstructure, said alloy carbon steel further comprising silicon at a concentration of from about 0.1% to about 3% by weight of said alloy composition.

12. An alloy carbon steel in accordance with claim **1** in which said carbon constitutes from about 0.05% to about 0.2% by weight of said triple-phase microstructure, said alloy carbon steel further comprising silicon at a concentration of from about 1% to about 2.5% by weight of said alloy composition, and containing substantially no carbides.

13. A process for manufacturing a high-strength, corrosion-resistant tough alloy carbon steel, said process comprising:

(a) forming an alloy composition comprising iron and at least one alloying element comprising a maximum of about 0.35% by weight of carbon in proportions selected to provide said alloy composition with a martensite transition range having a martensite start temperature of at least about 300°C;

(b) heating said alloy composition to a temperature sufficiently high to cause austenitization thereof, under conditions causing said alloy composition to assume a homogeneous austenite phase with all alloying elements in solution;

(c) cooling said homogeneous austenite phase sufficiently to transform a portion of said austenite phase to ferrite crystals, thereby forming a two-phase microstructure comprising ferrite crystals fused with austenite crystals; and

(d) cooling said two-phase microstructure through said martensite transition range under conditions causing conversion of said austenite crystals to a microstructure containing laths of martensite alternating with films of retained austenite.

14. A process in accordance with claim **13** in which step (d) comprises cooling said two-phase microstructure at a rate sufficiently fast to avoid the occurrence of autotempering.

15. A process in accordance with claim **13** in which step (d) comprises cooling said two-phase microstructure by contact of said two-phase crystal structure with water.

16. A process in accordance with claim **13** in which step (c) comprises cooling said homogeneous austenite phase to a temperature of from about 750°C to about 950°C.

17. A process in accordance with claim **13** in which step (c) comprises cooling said homogeneous austenite phase to a temperature of from about 775°C to about 900°C.

18. A process in accordance with claim **13** in which said carbon constitutes from about 0.01% to about 0.35% by weight of said alloy composition.

19. A process in accordance with claim **13** in which said carbon constitutes from about 0.03% to about 0.3% by weight of said alloy composition.

20. A process in accordance with claim **13** in which said carbon constitutes from about 0.05% to about 0.2% by weight of said alloy composition.

21. A process in accordance with claim **13** in which said alloy composition further comprises silicon at a concentration of from about 0.1% to about 3% by weight.

22. A process in accordance with claim **13** in which said alloy composition further comprises silicon at a concentration of from about 1% to about 2.5% by weight.